this we find some pertinent and useful hints on the best mode of grouping hardy perennials, and the art of managing the rock-garden, the wild-garden, water, and boggy ground; on the culture and propagation of early flowers, and other subjects dear to the dweller in the country. Compared with the art of gardening as practised twenty years ago, we are certainly now in an altogether new and improved epoch, and Mr. Robinson is one of the pioneers to whom we are mainly indebted for the introduction of a better and more rational style. A. W. B.

Hints on Shore-Shooting: with a chapter on skinning and preserving Birds. By James Edmund Harting, F.L.S., &c. (London: Van Voorst, 1871.)

A GOOD sportsman, whether he knows it or not, must be more or less of a good naturalist, and this Mr. Harting is. His unpretending little book, therefore, certainly deserves mention here, and the more so since he has worthily won his spurs by making the group of birds most sought by the "shore-shooter" an especial subject of study. What he tells us is the result of his own observation, and is pleasantly told. What he does not tell us is whether "shore-shooting" has, with most people,—for we except him—any other *raison d'être* than the "fine-day-let's-go-and-kill-something" impulse. If not, we really do not see that there is much difference in principle between Pagham and Hurlingham.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

An Universal Atmosphere

I HAVE much pleasure in replying to Mr. Browning's question in NATURE, vol. iv. p. 487, as it is one that legitimately strikes at the root of all my speculations, and which, if unanswerable, conveys an objection that must demolish the whole structure I have endeavoured to erect in my essay on the "Fuel of the Sun."

If I am right, the atmospheres of the sun, the moon, the planets, or of any other cosmical body of known mass and dimensions, may be calculated in units of the earth's total atmosphere by the simple formula reasoned out in Chap. iii. of the above-named work, *i.e.*, by multiplying the mass of the body (expressed in units of the earth's mass) by its own square root, thus

$$x = m \sqrt{m};$$

where x is the atmosphere of the body in question expressed in units of the earth's known total atmosphere, and m is the mass of the body expressed in units of the earth's mass.

The mass of the moon being $\frac{1}{80}$ that of the earth, we get $\frac{1}{80}\sqrt{\frac{1}{80}} = \frac{1}{715{\cdot}5416}$, or, discarding fractions, the moon's atmosphere as $\frac{1}{715}$ that of the earth. But the diameter of the moon being to that of the earth as 0·264 to unity, the lunar surface will be to that of the earth as $0{\cdot}264^2$ or 0·0697 to 1, and the lunar atmosphere will be concentrated accordingly, bringing the mean atmospheric pressure on the lunar surface to

$$\frac{\frac{1}{715}}{0{\cdot}0697} = \frac{1}{49{\cdot}8355}, \text{ or } \frac{1}{50},$$

nearly of that of the earth's mean atmospheric pressure. Such an atmosphere would support a column of mercury six-tenths of an inch in height. Mr. Browning will recognise this as about equal to the best vacuum obtainable in an old-fashioned air-pump of average defectiveness.

Such is the theoretical pressure upon every part of the moon's surface, supposing the form of the moon to be a perfect spheroid of rotation with a perfectly smooth surface. But the moon is no such regular body. It presents far more irregularities in proportion to its size than would our earth if the ocean were evaporated, and its depths laid bare so that our mountain heights should be measured from the ocean bottom. Under such conditions the bulk of even our atmosphere would occupy the ocean valleys, and very rare indeed would be the remainder that reached the mountain tops and elevated ridges of the earth. On the moon with its filmy atmosphere of only six-tenths of an inch mean pressure, the rarefaction on the high lands and mountains would be carried beyond the limits of observable refractive power under the conditions assumed—viz., of a special atmosphere merging gradually into the universal interstellar medium.

The visible edge of the moon which effects the occultation of a star must in almost every possible case be formed by the ridges and summits of the lunar mountains, in no case by the bottom of the lower valleys, for in looking horizontally across the moon's rotundity these valleys and even the maria must be foreshortened, and their lower depths walled out of the reach of our vision by the great lunar elevations. Thus the occultation of a star would occur without its previous plunging behind any outlying lunar atmospheric matter of appreciable density. We must not forget that Sir J. Herschel's calculation, which assigns one second of refraction to an atmosphere equal to $\frac{1}{1980}$ of the density of the earth, is based on the theory of a limited atmosphere with a sharp and definite boundary suddenly terminating in a vacuum.

But this rarefaction on the elevated portions of the moon demands a compensating condensation or concentration of atmospheric matter in the valleys, crater-pits, and maria. Here the pressure on the moon's surface should considerably exceed the calculated mean. This consideration suggests a very interesting question. Would such an atmosphere, say capable of supporting one inch of mercury, produce any observable effects? If I am right in regarding water as one of the constituents of the universal atmosphere, there are good reasons for supposing that it would.

The small share of water due to the moon would all be raised far above its low boiling point, early in the lunar day, by the heated lunar surface. There would be no sea, no clouds, no rain, no snow, but on the plains and in the valleys a formation of hoar-frost should occur at the lunar eventide, beginning just where the sun's rays become too oblique to maintain the temperature of the rapidly radiating lunar surface above the freezing-point.

In a note appended to Mr. Lockyer's translation of M. Guillemin's work on "The Heavens," the Rev. T. W. Webb thus corrects the author's rather positive statements concerning the total absence of a lunar atmosphere: "After all fair deductions on the score of imperfection of observation or precipitancy of inference, there are still residuary phenomena, such as, for instance, the extraordinary profusion of brilliant points which on rare occasions diversify the Mare Crisium, so difficult of interpretation, that we may judge it wisest to avoid too positive an opinion." Now the Mare Crisium is a great depression of the lunar surface close upon that edge of the moon which, to our vision, first receives and loses the solar illumination. If I am right, aqueous vapour should be suddenly forming there during the early crescent period after the new moon, and the hoar-frost should be as suddenly precipitated as this wide depression rolls towards the darkness after the full moon. In that chapter of the "Fuel of the Sun" which is devoted to the meteorology of the moon and Mercury, I have discussed some of the theoretical results of these conditions and the appearances they should present. I may here merely add that, as the temperature of any part of the moon's unmantled surface must directly and very rapidly vary with the incidence of solar radiation, all the undulating regions of the moon must at morning and evening have a very patchy temperature, the slopes towards the sun being hotter than our tropics, while the opposite side of the same hill receiving the solar rays with great obliquity, and radiating into space almost without impediment, must retain a freezing temperature, and thus the cryophorous phenomena, which Sir John Herschel describes as a possible result of the contrasted temperatures of the opposite sides of the moon, should be effected even by the shady lunar craters and contrasted hill-slopes.

On the highlands of the moon no appreciable amount of hoar-frost precipitation should take place on account of the absence of sufficient atmosphere; but on the deeper maria, wherever the conditions are the most favourable, the patchy temperature should produce patches of such precipitation. If anywhere visible, these should be seen on the Mare Crisium, on account of its proximity to the edge of the moon, for there the morning rays that strike most obliquely upon the cold slopes would be the most effectively reflected towards the earth. Not

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having seen any original or detailed account of the phenomena to which Mr. Webb alludes, I am unable to say whether they fulfil these theoretical conditions, but I believe that something more may be learned by means of careful observations specially directed to the elucidation of the questions I have suggested.

W. MATTIEU WILLIAMS

Woodside, Croydon, Oct. 23

Pendulum Autographs

IT may interest some of your readers to know that they can for themselves observe in the most accurate manner the motion of the compound pendulum described by Mr H. Airy* by merely attaching the ends of a fine thread to two points in the ceiling of a room, and suspending a leaden bullet by means of a second thread tied to the middle point of the former, so that the bullet may just escape the floor. Lay underneath a large sheet of white paper ruled with two dark lines at right angles to each other to correspond to the two axes of vibration. It is Mr. Airy's experiment with the hoop on an extended scale. The motion of the bullet, unimpeded by contact of pencil with paper, is graceful and accurate in the extreme.

Perhaps the most remarkable case is that in which the two points of suspension are taken about an inch apart, and the third about half an inch below them; the pendulum will now keep reversing its motion as uniformly as before, and apparently without any adequate cause, a matter of astonishment to the uninitiated spectator.

I believe the general equation to the path, including all the curves described, will be found to be $\sqrt{n}\, cos^{-1}\frac{x}{a} = \sqrt{m}\, cos^{-1}\frac{y}{b}$, where the particle starts from the point (a, b) and is attracted to the axes of X and Y by forces $= -ny$ and $-mx$ respectively.

Woolwich, Oct. 24 GEO. S. CARR

Exogenous Structures in Coal Plants

I CORDIALLY agree with your recommendation that discussion on the Exogenous Stems of the Coal Measures should cease for the present. It is evident that I shall not convince my two opponents, and they are as far as ever they were from convincing me. But I must request that in justice to me, you will allow me to enter a protest against the last paragraph of Prof. Dyer's article, in which he objects to my applying the term Protoplasmic to the cambium layer, and endeavours to show that I am two hundred years behind the age in my physiology. I cannot but think that Prof. Dyer, when he penned that paragraph, knew perfectly well in what sense I used that expression. I meant by it nothing more than is implied in the following sentence, taken from Prof. Balfour's "Manual of Botany," p. 43, which certainly does not belong to the age of Grew:—

"External to the woody layers, and between them and the bark, there is a layer of mucilaginous semifluid matter, which is particularly copious in spring, and to which the name Cambium has been given. In this are afterwards found cells, called Cambium Cells, of a delicate texture, in which the protoplasm and primary utricle are conspicuous."

W. C. WILLIAMSON

Fallowfield, Oct. 25

*** This correspondence must now close.—ED.

Classification of Fruits

IT seems from the numerous attempts that have been made that a philosophical classification of fruits is either unattainable or practically of very little value when attained. At any rate working botanists have, as a rule, discarded the majority of the carpological terms that are to be found in text-books as too cumbrous or too uncertain in their application. Among the latest attempts at simplification in the matter of the classification of fruits are those of my friends Prof. Dickson and Dr. M'Nab (see NATURE, vol. iv. p. 475). Both of these are open to some criticism on matters of detail, but I can hardly expect you to accord me space to point out what I believe to be the merits or shortcomings of their respective schemes. I should also trespass too much on your courtesy and on the patience of your readers did I enter into any engthened explanation of the following scheme, in which I have adopted to some extent the nomenclature of Prof. Dickson and Dr. M'Nab, and which I offer for consideration solely on the grounds of expediency and simplicity:—

Classification of Monothalamic Fruits

A. Ripe pericarp uniform	
Fruits indehiscent	I. Nuts or Achænocarps.
Fruits dehiscent	II. Pods or Regmacarps.
B. Ripe pericarp of two or more layers of different substance *	
Seeds within a hardened endocarp	III. Stone-fruits or Pyrenocarps.
Seeds embedded in pulp*	IV. Berries or Sarcocarps.

I. *Nuts or Achænocarps*

WINGLESS—	
Fruit of one carpel, or, if of more, apocarpous	Achene
Fruit of more than one carpel	
Carpels ultimately separate but indehiscent	Carcerule (Cremocarp).
Carpels inseparate	
Pericarp adherent to the seed	Caryopsis.
Pericarp free from the seed, within a cupule	Glans.
WINGED	Samara

II. *Pods or Regmacarps*

Fruit of one carpel	
Opening by one suture	Follicle
two sutures	Legume
transversely	Lomentum (Dichisma, *M'Nab*)
Fruit of more than one carpel	
Opening by pores or sutures	Capsule (Siliqua) (Regma) (Conceptaculum) (Tryma, &c.).
Opening transversely	Pyxis.

III. *Stone-fruits or Pyrenocarps*

Carpels one or more, superior	Drupe (Fibro-drupe as in *Cocos*, *Grewia*, sp., &c.).
Carpels one or more, adherent to, or enclosed within a fleshy receptacle	Pome (Sphalerocarpium, as in *Hippophae*)

IV. *Berries or Sarcocarps*

Seeds embedded in pulp	Bacca (Hesperidium) (Uva) (Pepo).

I believe that the foregoing arrangement will include most of the varieties of fruits and seed-vessels, though, as in all similar cases, exceptional forms are not readily sorted into their proper place; the fruit of such Cassias as *C. Fistula*, generally called a lomentum, is a case in point. For general purposes the varieties enclosed in brackets may well be omitted, save in the case of so well known and constantly used a term as *siliqua*, which, despite Prof. Dickson's veto, I think is too useful practically to be lightly abandoned.

MAXWELL T. MASTERS

The Berthon Dynamometer

ABSENCE from home, and many engagements, have prevented an earlier reply to "W. R.'s" letter in NATURE, October 5. In my previous communication I believe I gave the address of the inventor, to whom I thought reference might naturally be made; in order, however, to meet "W. R.'s" wish, I will explain the construction of the very simple but efficient instrument in question. It is merely a V gauge, formed of two pieces of thin brass converging at a very acute angle, and graduated along one of the edges; the divisions being viewed through a lens held in the

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* See NATURE, vol. iv pp. 310, 317.

* The pericarp is here understood as including not only the ripened carpellary wall, but also any adjunct to it which in process of development may be combined with it. In the same manner the pulp may be a production from the carpel or from the seed itself.

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